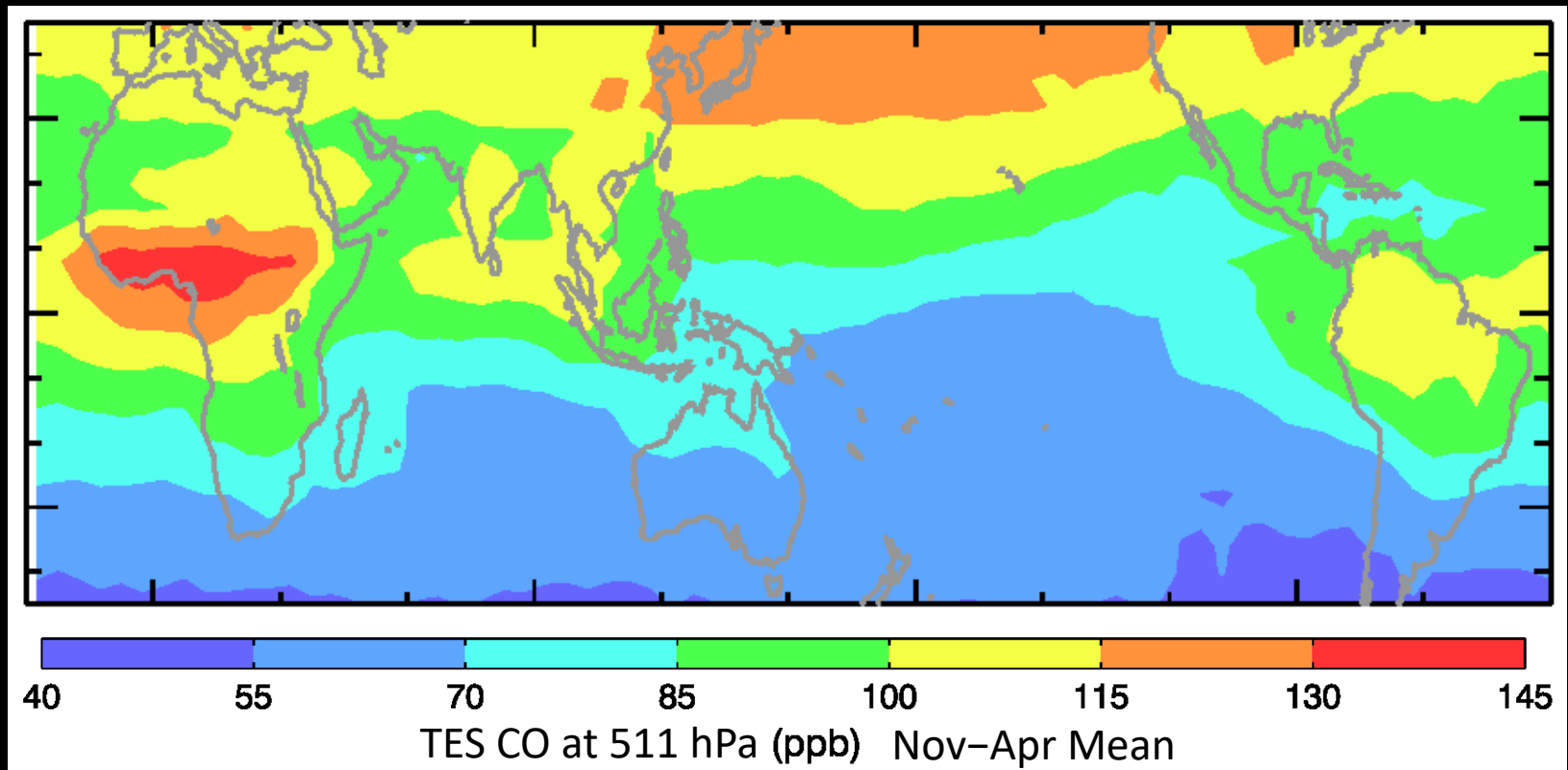


The MJO modulation in CO

King-Fai Li (UC Riverside, king-fai.li@ucr.edu)

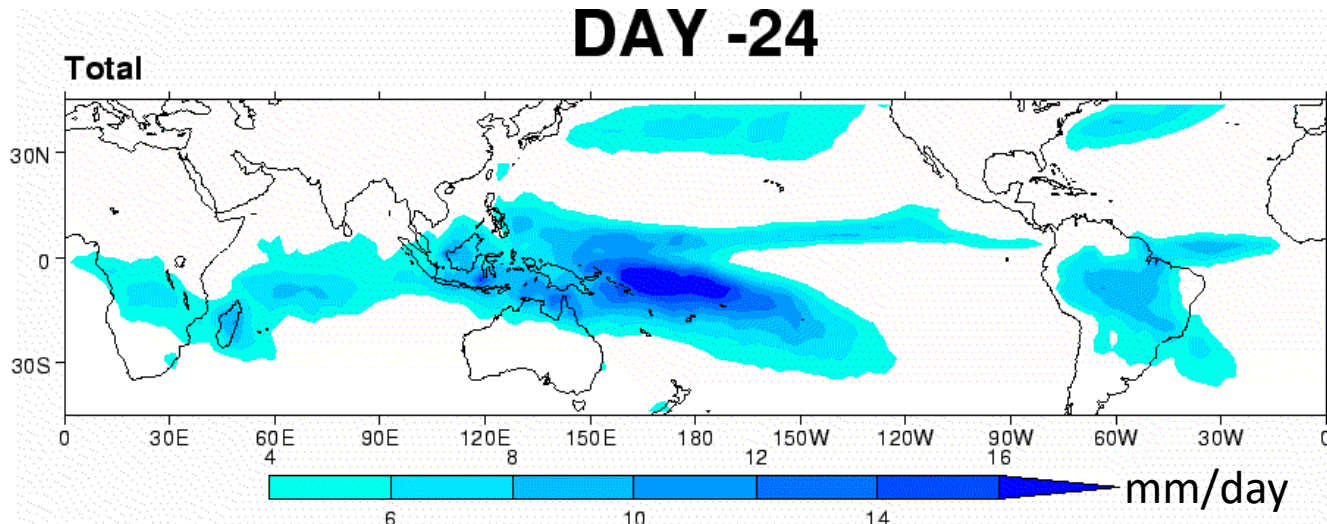
Contributor: Mao-Chang Liang (Academia Sinica)

Supported by ACCDAM (PI K-K Tung, U Washington)



Madden-Julian oscillation

- ❖ Life cycle $\sim 40\text{--}60$ days
- ❖ Semi-predictable organized convection events
- ❖ Help study effects of convection on tracers



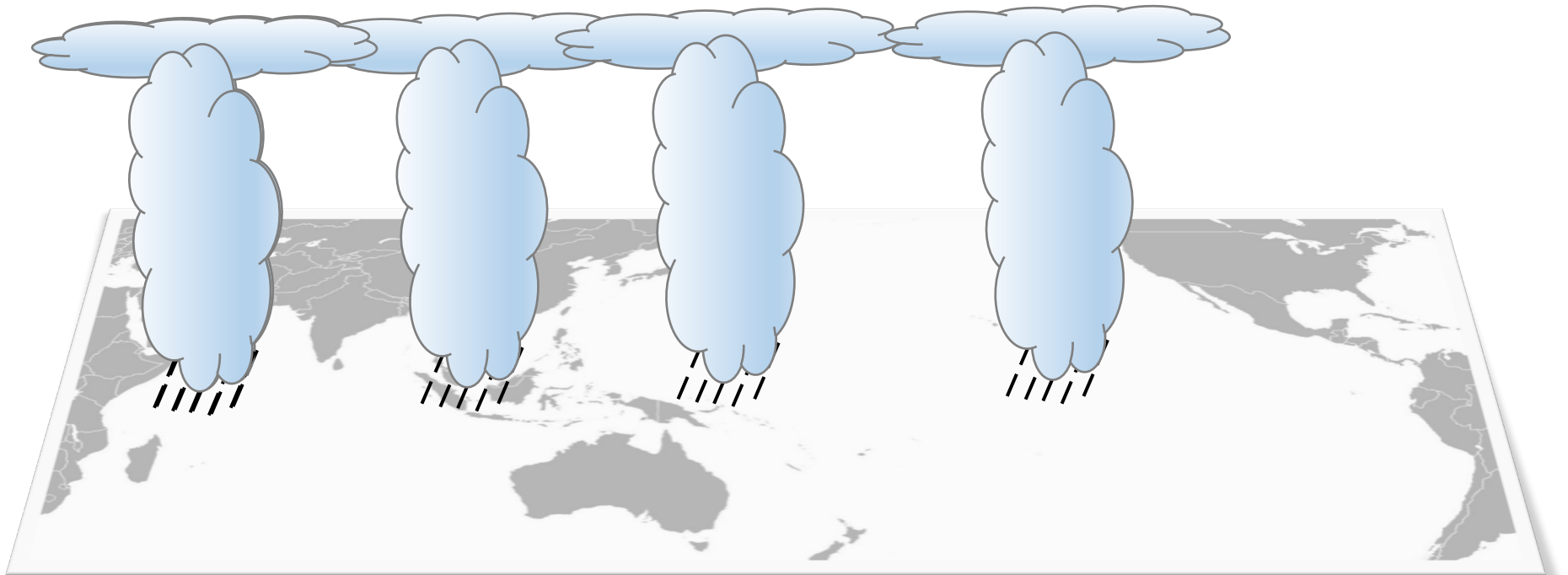
MJO Phases

Phase 1
W. Indian
Ocean

Phases 2–3
Indonesia

Phases 4–5
W. Pacific

Phases 6–8
E. Pacific

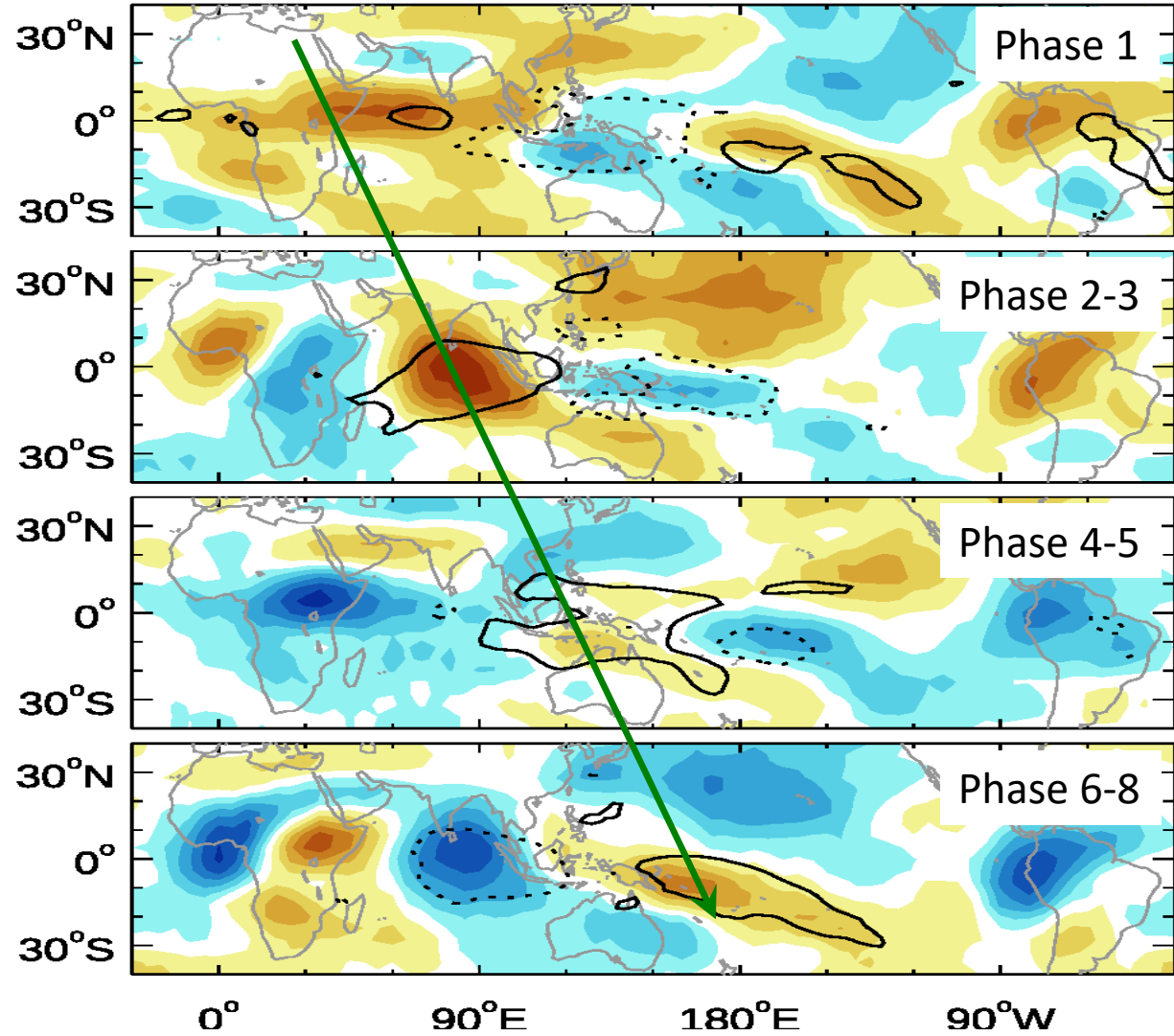


CO: a better probe of overshooting convection in TTL

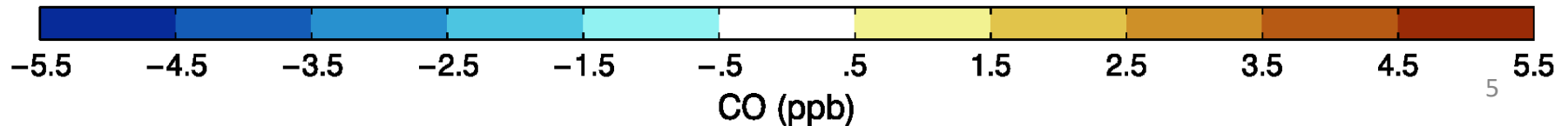
- ❖ Wong & Dessler [2007] used 7 months of MLS CO data to investigate how overshooting convection may affect the thermal structure and composition in TTL.
- ❖ The Madden-Julian oscillation (MJO) is used to help identify overshooting convection across the tropics
- ❖ Unlike H₂O, CO injected by overshooting convection does not condense at 365 K and continues to go up to 375 K.
- ❖ TTL CO is increased where convection is enhanced by MJO
- ❖ The MJO-related variation of the tropical-mean CO (10°N–10°S) is dominated by injection over Africa.

15 years of MLS CO data confirms Wong and Dessler [2007] finding

215 hPa

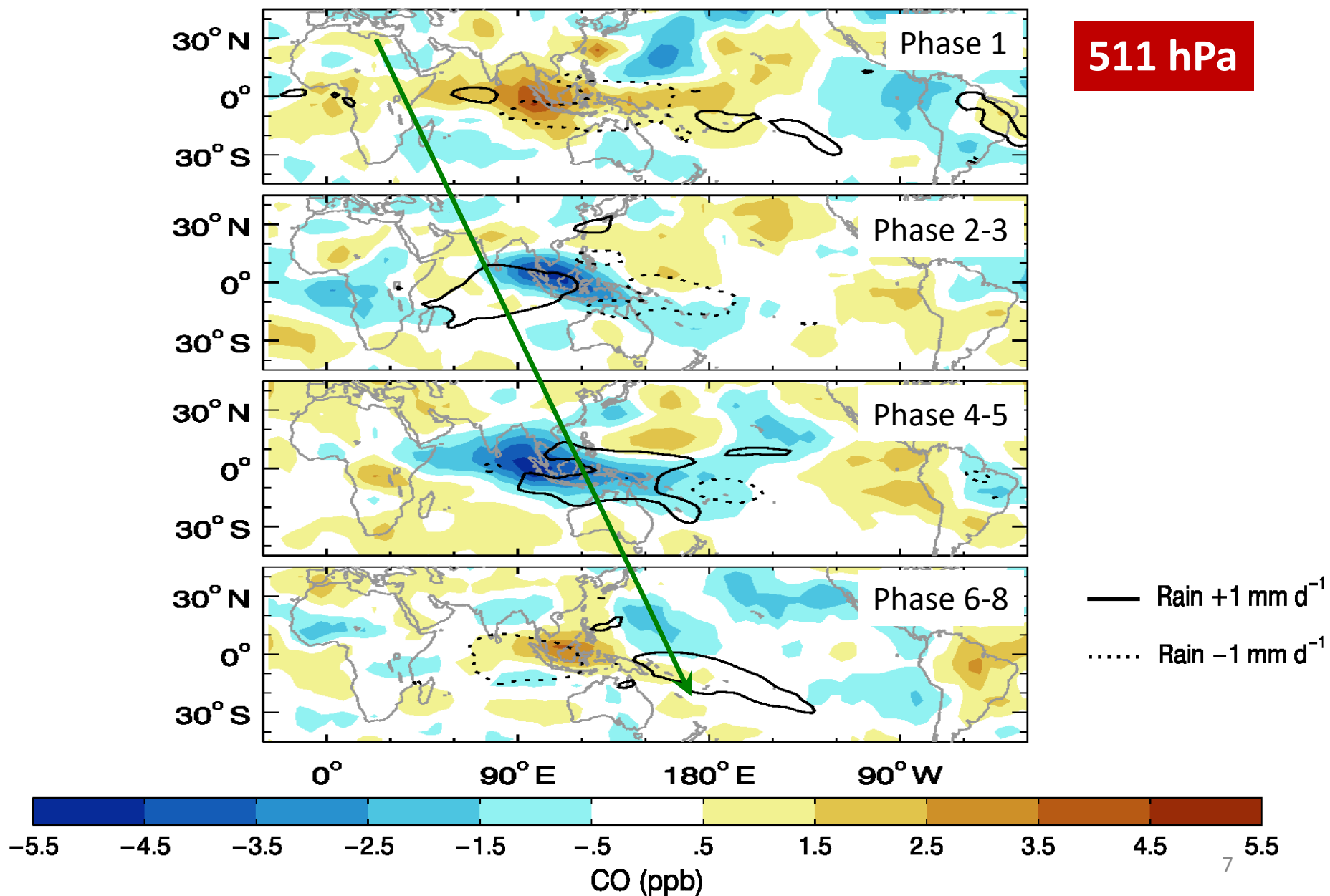


— Rain +1 mm d⁻¹
..... Rain -1 mm d⁻¹



How about tropospheric CO?

TES reveals less mid-tropCO over convective regions, opposite to TTL CO



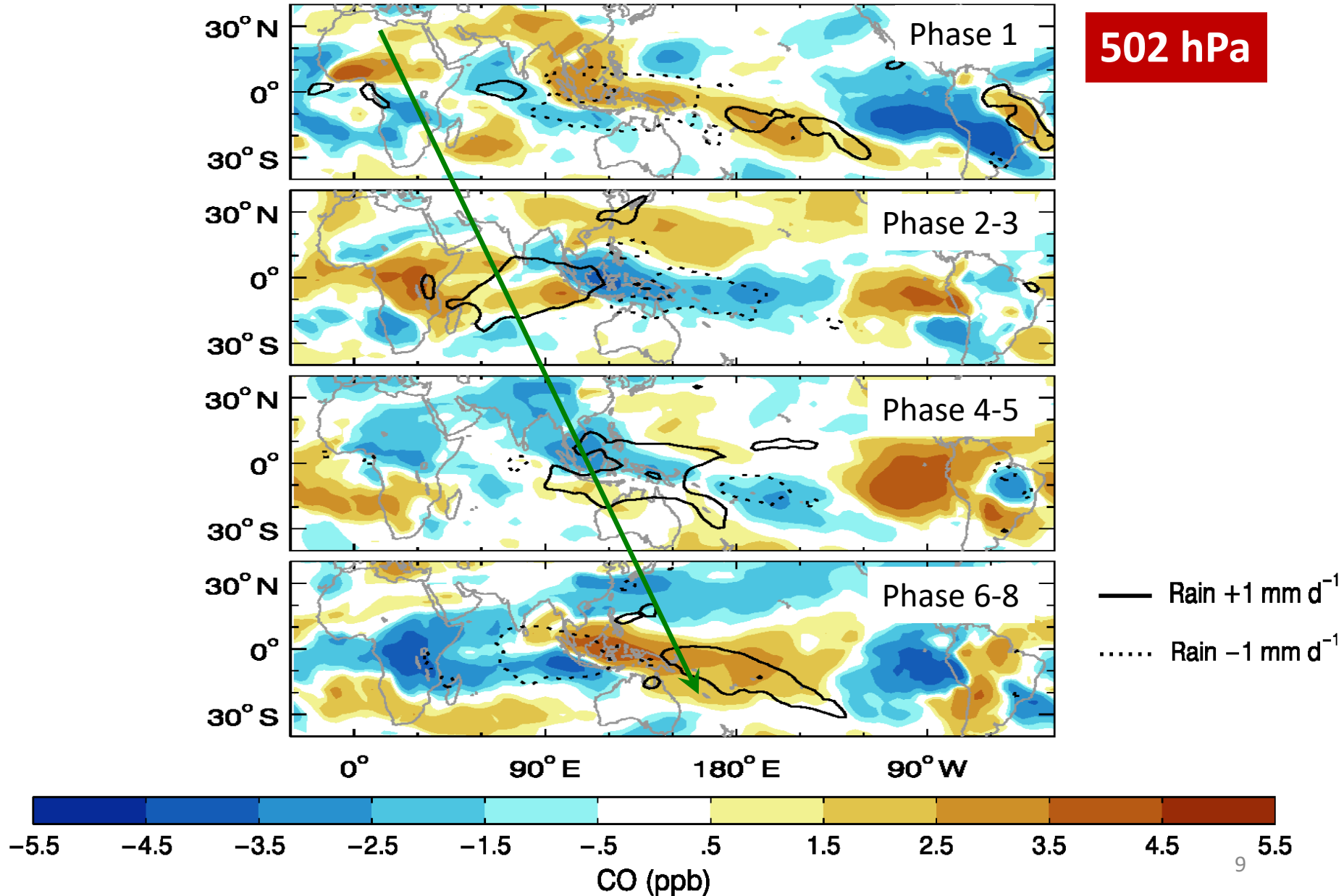
Possible explanations

- ❑ Enhanced rainfall by the MJO reduces CO emission from biomass burning over land
- ❑ Increased cloud cover by the MJO reduces CO production over land from CH₄ photolysis

MOZART Model

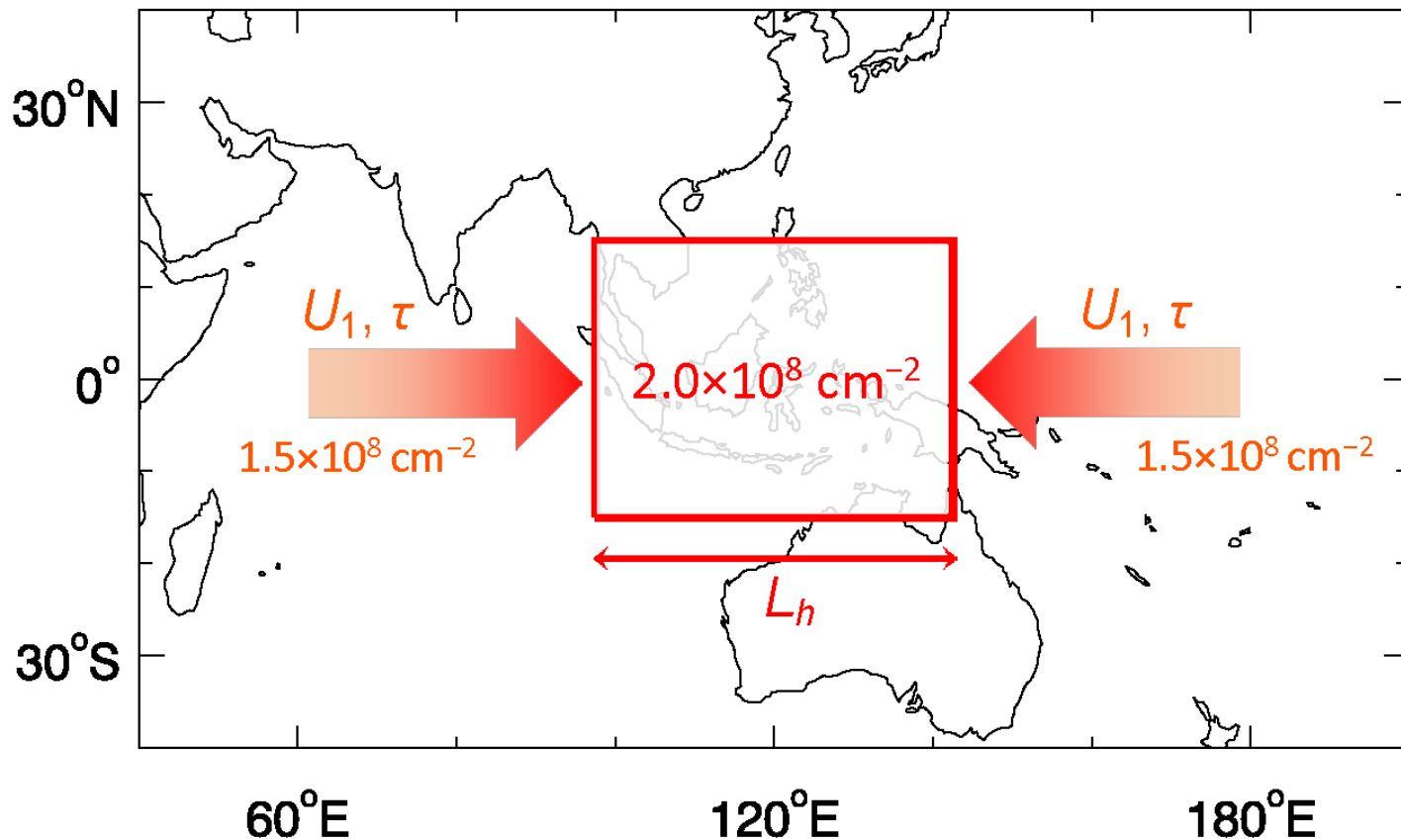
- ❑ Monthly CO surface flux (i.e. no MJO in CO emission)
- ❑ Set CO as a pure dynamical tracer (i.e. turn off all chemistry and photochemistry)

This special MOZART setup reproduces the observed anticorrelation



Proposed mechanism: Horizontal convergence over the scale of MJO dilutes the anthropogenic emissions from the Maritime Continents.

Li and Liang [JGR, under review]



Food for thoughts

- ❑ Spatial variations in tropospheric chemical tracers due to **fast, large-scale processes** do not necessarily imply changes in surface fluxes.
- ❑ Our results based on CO are likely applicable to other long-lived pollutants.
- ❑ Flux inversions should be always quantified with uncertainties from dynamics alone.